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Research on Black Mesa -- A Progress Report

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IN COOPERATION WITH

COLORADO AGRICULTURAL EXPERIMENT STATION, COLORADO STATE UNIVERSITY
FISH AND WILDLIFE SERVICE, U. S. DEPARTMENT OF THE INTERIOR
AND BLACK MESA CATTLEMEN'S ASSOCIATION

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RESEARCH ON BLACK MESA -- A PROGRESS REPORT

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CONTENTS

	Page
Grazing management	2
Watershed management	6
The relation of plant and ground cover to runoff and sediment production	6
Relative water use by aspen, spruce, and grassland .	8
Range rodents	10
Pocket gophers	10
Habits and life history of the pocket gopher . . .	10
Pocket gopher food habits	12
Pocket gopher effects on range and watershed values	14
Pocket gopher control	17
Trends in rodent numbers	18

Central headquarters for the Rocky Mountain Forest and Range Experiment Station is maintained in cooperation with Colorado State University at Fort Collins; research reported here is being conducted on the Black Mesa, Gunnison National Forest.

RESEARCH ON BLACK MESA -- A PROGRESS REPORT

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During the past 5 years a sizable research program has been developed on Black Mesa in southwestern Colorado. This brochure describes briefly what the program consists of and what has been learned to date.

Black Mesa was chosen as an experimental area primarily for the study of range and watershed problems. Located at an elevation of about 10,000 feet, it is representative of high mesas and plateaus along the western slope of the central Rockies. Thurber fescue grassland parks, interspersed with groves of aspen and spruce, provide forage for cattle during summer months. Precipitation averages approximately 25 inches, but varies greatly from year to year. Two-thirds is received as snow and one-third as spring and summer showers. Timbered areas provide forest products for local needs, and the entire area yields much runoff from snowmelt. Wildlife, especially deer, elk, and small rodents, are also important. Studies on Black Mesa are aimed to provide a better understanding of these lands, their capabilities and resources, as a basis for more efficient use in the future.

Grazing and watershed management studies are being conducted by the U. S. Forest Service in cooperation with Black Mesa Cattlemen's Association. Range rodent investigations entail close cooperation and joint attack by Colorado Agricultural Experiment Station, U. S. Fish and Wildlife Service, and the U. S. Forest Service.

Physical facilities include 6 experimental pastures, corrals, scales, stock-water developments, 3 stream-gaging stations, and many temporary and permanent plots for studying pocket gophers. The entire study area is located on the Gunnison National Forest.

GRAZING MANAGEMENT

Efficient use of Thurber fescue grasslands depends largely on how plants and livestock respond to different methods of grazing. The present study is a comparison of the ecological changes and cattle production at different levels of grazing.

The general objective of the study is to determine how to get the range into full production and keep it there. More specifically, information is being sought on the following:

1. Effect of different intensities of season-long grazing on production of important forage plants.

2. Effect of different grazing rates on cattle weight gains and total beef production.

3. Forage value of aspen stands when grazed in conjunction with grasslands.

4. Reliable indicators of range improvement or range deterioration.

5. Extent of variation in forage production from year to year due to weather.

6. Proper grazing of Thurber fescue grassland and aspen ranges with cattle for efficient use of the forage crop.

Methods of study

Six experimental pastures were fenced in 1954 to control grazing. Ranging in size from roughly 100 to 400 acres, they contain large grassland parks intermixed with aspen and spruce forest. The pastures are grazed by yearling steers furnished by Black Mesa Cattlemen's Association from about July 15 to October 1. Animals are tagged and weighed individually to provide a record of weight gain (fig. 1).

Records are maintained on forage production, utilization, and plant cover by individual species and ground cover. Weather records are also maintained.

Figure 1. --Grass-fat from grazing experimental pastures, these steers are now ready for the feedlot. Summer gains usually average 2 pounds per day.

Beginning in 1954 all pastures were grazed as nearly alike as possible for 3 years. The object was to determine the approximate grazing capacity of each pasture and to learn how much variation in animal weight gain might be expected under such grazing. In 1957 stocking rates were adjusted to achieve different levels of grazing. The goal is to utilize 25, 40, and 55 percent of the grass in the open parks. Two pastures are assigned each grazing treatment.

Results to date

As shown in table 1, the number of steers was increased substantially during the period of calibration in an attempt to achieve about 40 percent use of Idaho fescue, a key forage species. While increased stocking resulted in closer grazing, utilization during any given year was quite similar in all pastures.

Table 1.--Records of pasture stocking, forage utilization, and cattle weight gains on Black Mesa Experimental Range, 1954-58

Grazing use and date		Steers	Average use of Idaho fescue	Average daily steer gain
		No.	Percent	Pounds
Light grazing use (pastures 2 & 4)				
Calibration period:	1954	37	17	2.14
	1955	74	22	1.89
	1956	78	40	2.10
Treatment period:	1957	52	14	2.44
	1958	52	20	1.84
Moderate grazing use (pastures 1 & 6)				
Calibration period:	1954	42	12	2.22
	1955	84	18	1.85
	1956	122	42	2.13
Treatment period:	1957	119	28	2.14
	1958	119	34	2.04
Heavy grazing use (pastures 3 & 5)				
Calibration period:	1954	35	19	2.24
	1955	70	24	1.89
	1956	83	41	2.16
Treatment period:	1957	109	41	2.26
	1958	109	46	1.90

Little difference in cattle weight gains was observed among the three pairs of pastures during the calibration period. Neither was there much difference due to increased stocking. Gains in 1955 were considerably lower than in 1954 and 1956. Oddly enough, grass production in 1955 was the highest on record.

Following the calibration period stocking was increased about one-third on two pastures and reduced one-third on two others. This resulted in a fairly wide range in use of Idaho fescue but less use than was planned for all intensities.

In 1957 grazing began July 30, 2 weeks later than usual, because of a late spring. Rainfall was abundant and forage remained green and succulent throughout the summer. Animals in lightly grazed pastures gained 14 percent more than those in the pastures grazed at the medium rate, and 8 percent more than those in the pastures grazed at the heaviest rate. The difference between medium and heavy rates was not significant.

In 1958 cattle weight gains were not related to grazing intensity. In fact, animals in lightly grazed pastures gained least. Although forage was abundant, it was extremely dry during most of the grazing period.

Comparative utilization of the three major grasses on the pastures grazed at the medium rate has been as follows:

	Average percent utilization				
	1954	1955	1956	1957	1958
Idaho fescue (Festuca idahoensis)	12	18	42	28	34
Thurber fescue (Festuca thurberi)	2	10	14	22	34
Letterman needlegrass (Stipa lettermanii)	7	10	22	20	28

Prior to 1958, Idaho fescue was grazed more closely than the other important grasses. However, in 1958 Thurber fescue was grazed as much as Idaho fescue.

Other findings are as follows:

1. Over a 5-year period steer gains ranged from 2.3 to 2.7 pounds per day during the July-August period, compared with 1.1 to 1.7 pounds per day during September.

2. Average beef production of all pastures ranged from an average of 27 pounds per acre of grassland in 1954, when pastures were lightly grazed, to an average of 61 pounds in 1956, when they were more fully stocked.

3. Grass production in the pastures grazed at the medium rate has varied from 500 to 900 pounds per acre, air-dry.

4. Forage in aspen groves has generally been grazed very little; however, increased use is evident in pastures that are now grazed most heavily.

WATERSHED MANAGEMENT

THE RELATION OF PLANT AND GROUND COVER TO RUNOFF AND SEDIMENT PRODUCTION

Judging the condition of grazed watersheds similar to Black Mesa is now based largely on general observation or on criteria that may or may not be reliable. Yet it is highly important that watershed condition be judged accurately to prevent excessive erosion and realize optimum yields of usable water and forage.

Methods of study

Runoff, sediment, and plant and ground cover are measured on three watersheds within the Black Mesa experimental pastures (fig. 2). Beginning in 1957 the watersheds were subjected to different grazing treatments as part of the grazing intensity study. Changes in plant and ground cover are determined from permanent transects. Measurements of runoff and suspended sediment were started in 1956 and 1957, together with measurement of precipitation, temperature, and soil moisture.

Results to date

Although the snowmelt period varies from year to year, the streamflow charts indicate the relative magnitude and duration of runoff from the watersheds before different grazing treatments were started (fig. 3).

In 1957 practically all runoff occurred during June. Runoff from watershed 6 (272 acres) reached a higher peak and extended over a longer period than that from watershed 5 (169 acres) or watershed 4 (91 acres).

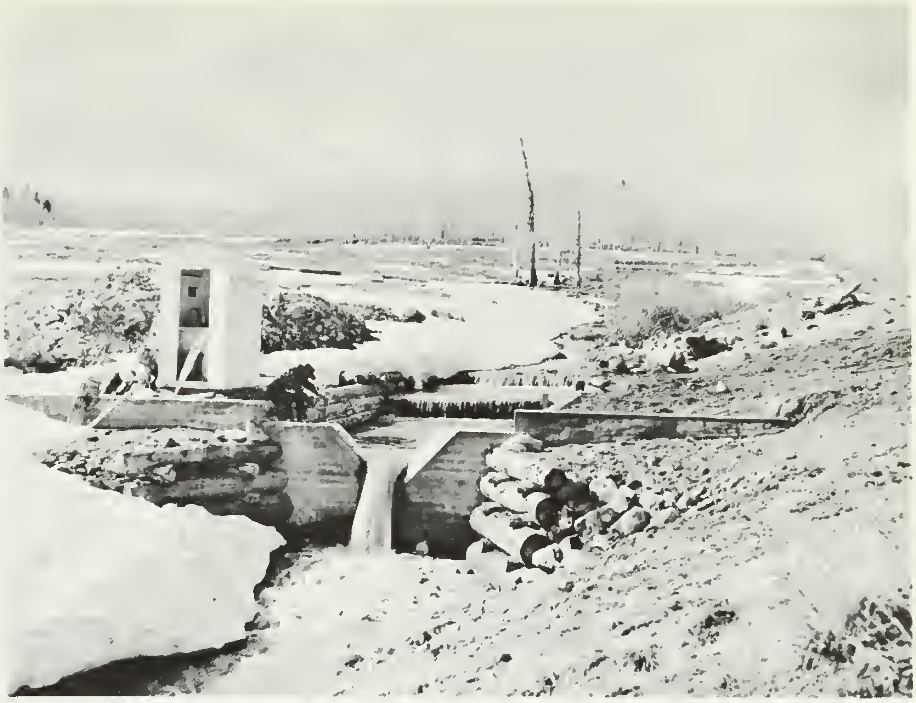

Figure 2. --Stream-gaging stations are used on Black Mesa to learn how runoff and sediment yield are affected by changes in ground cover.

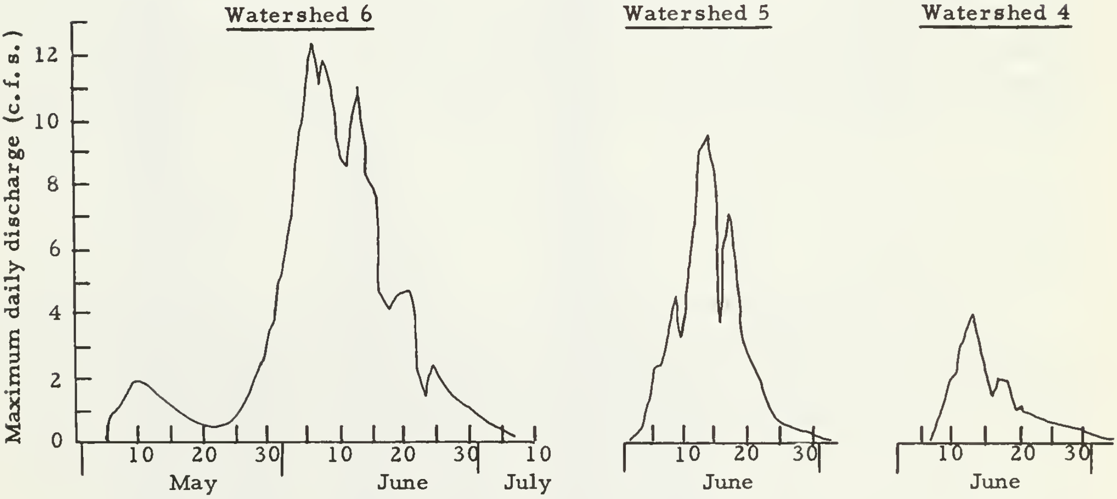

Figure 3. --Maximum daily streamflow from Black Mesa watersheds during 1957 snowmelt period.

Suspended sediment at the time of peak runoff from snowmelt amounted to 1,830 parts per million for watershed 5 compared with 765 and 675 p.p.m. for watersheds 4 and 6.

Though runoff from summer storms on Black Mesa may be insignificant, it carries much more sediment per unit of runoff. A maximum concentration of 11,510 p.p.m. was recorded from one such storm in 1957.

RELATIVE WATER USE BY ASPEN, SPRUCE, AND GRASSLAND

The demand for water in the West will soon exceed the present supply. It is important, therefore, to explore all possible means of increasing water yields. One possibility is to reduce the amount of water used by plants at the higher elevations, thus making more water available for streamflow.

The amount of water withdrawn from the upper 8 feet of soil under aspen, spruce, and grassland cover types is being compared.

Methods of study

Soil samples are taken in spring and fall for moisture determination (fig. 4). The difference in moisture content, plus precipitation, is considered to be the amount of water used during the summer. Several sites under each type of plant cover are sampled. Measurements were taken in 1955, 1957, and 1958.

Results to date

The amount of water used by each of the three vegetation types is significantly different. Aspen used an average of 20 inches during the growing season, spruce used 14 inches and grassland only 8 inches (fig. 5). The amounts of water withdrawn from the 0 to 4-foot soil layer in the aspen and spruce types was found to be about the same. Grassland used less water than spruce or aspen in the 0 to 4-foot layer and used practically no water below 4 feet.

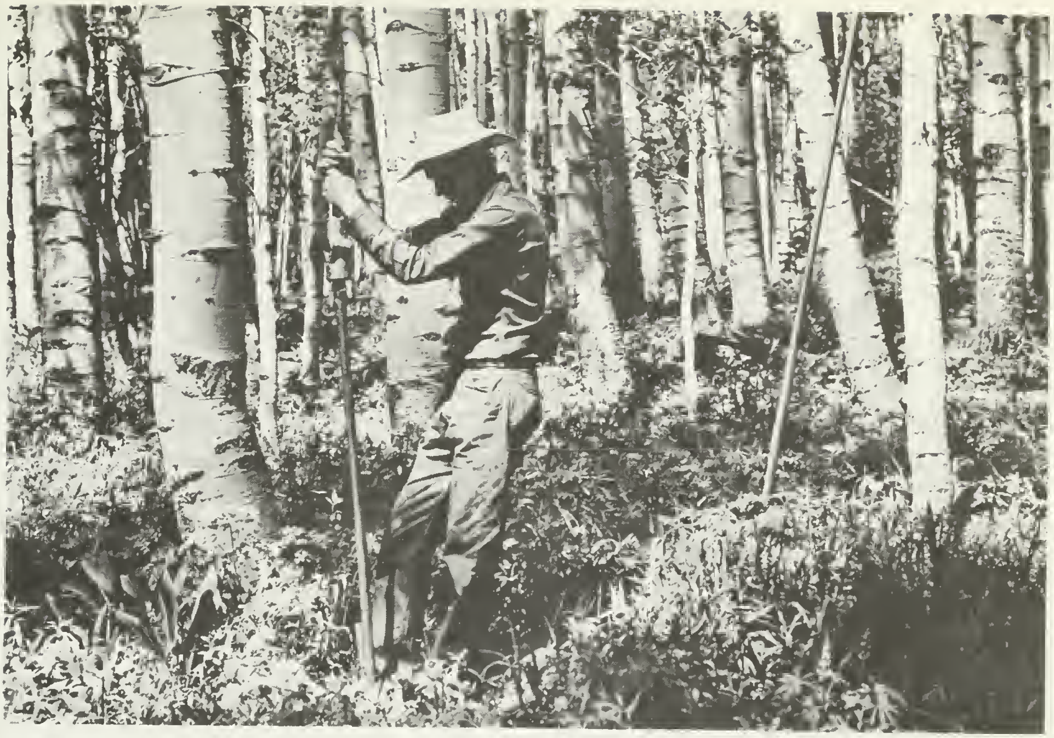

Figure 4. --Extracting soil cores for moisture determination in an aspen stand.

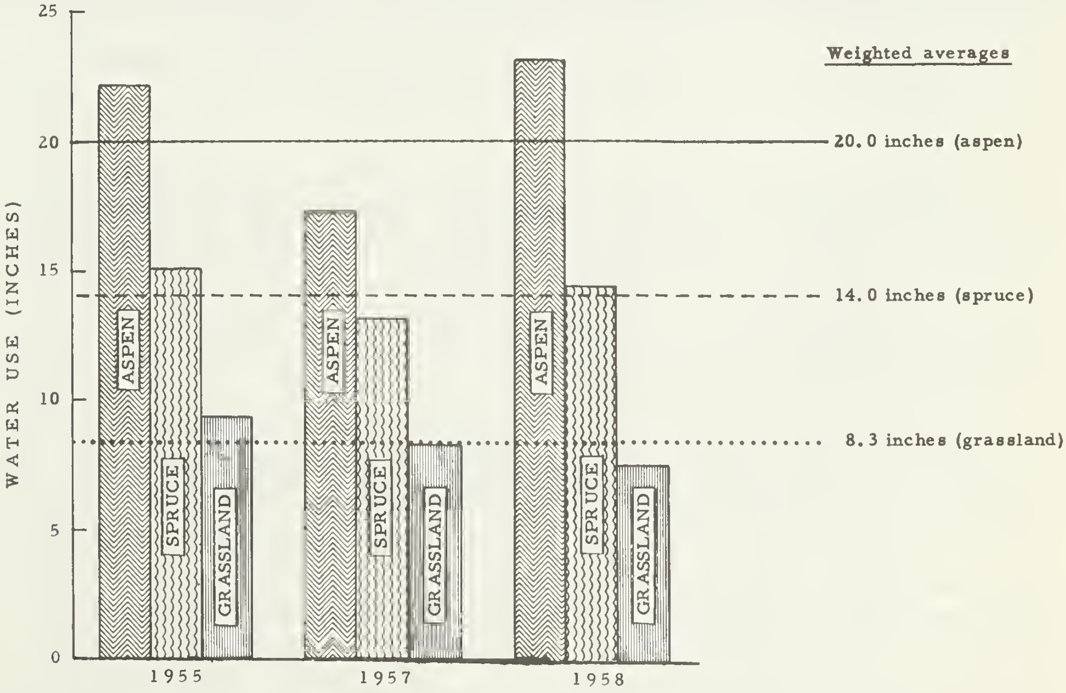

Figure 5. --Relative water use by aspen, spruce, and grassland to depth of 8 feet on Black Mesa during summer growing season.

RANGE RODENTS

POCKET GOPHERS

The Colorado Cooperative Pocket Gopher Project was organized in 1955. Three research agencies are cooperating in the studies. The Denver Wildlife Research Laboratory of the U. S. Fish & Wildlife Service is investigating food habits and practical methods for controlling gophers under field conditions. The Colorado Agricultural Experiment Station is conducting studies of the biology and life history of the gopher. The Forest Service is studying the effects of pocket gophers on range vegetation, soils, and watershed values. However, all agencies assist in all phases.

Pocket gophers are native to a large part of western United States (fig. 6). They are true burrowers and are seldom seen aboveground. The mounds of dirt they push to the surface as they excavate their tunnels indicate their presence.

Gophers have external fur-lined cheek pouches that are used for carrying food. Their incisor teeth always protrude from their mouth. Since their eyes and ears are small, the senses of seeing and hearing are probably not well developed. However, their sense of touch is acutely developed, and it is said they can run backward in a tunnel as fast as they can run forward, using their tail to guide them.

Pocket gophers have long been recognized as being incompatible with agriculture because they destroy crops, weaken irrigation systems, and otherwise interfere with farming operations. On rangelands, however, much less is known about the gopher, its net effect on forage production, and possible economic control measures.

Habits and Life History of the Pocket Gopher

To effectively control an animal it is necessary to understand its population dynamics. Animal populations are not static; they rise and fall from year to year and are sometimes cyclic. Survival of young, which largely determines the abundance of pocket gophers, varies considerably. The young usually suffer high mortality. If adverse conditions reduce the number of older animals, more young may be able to survive. Land will support

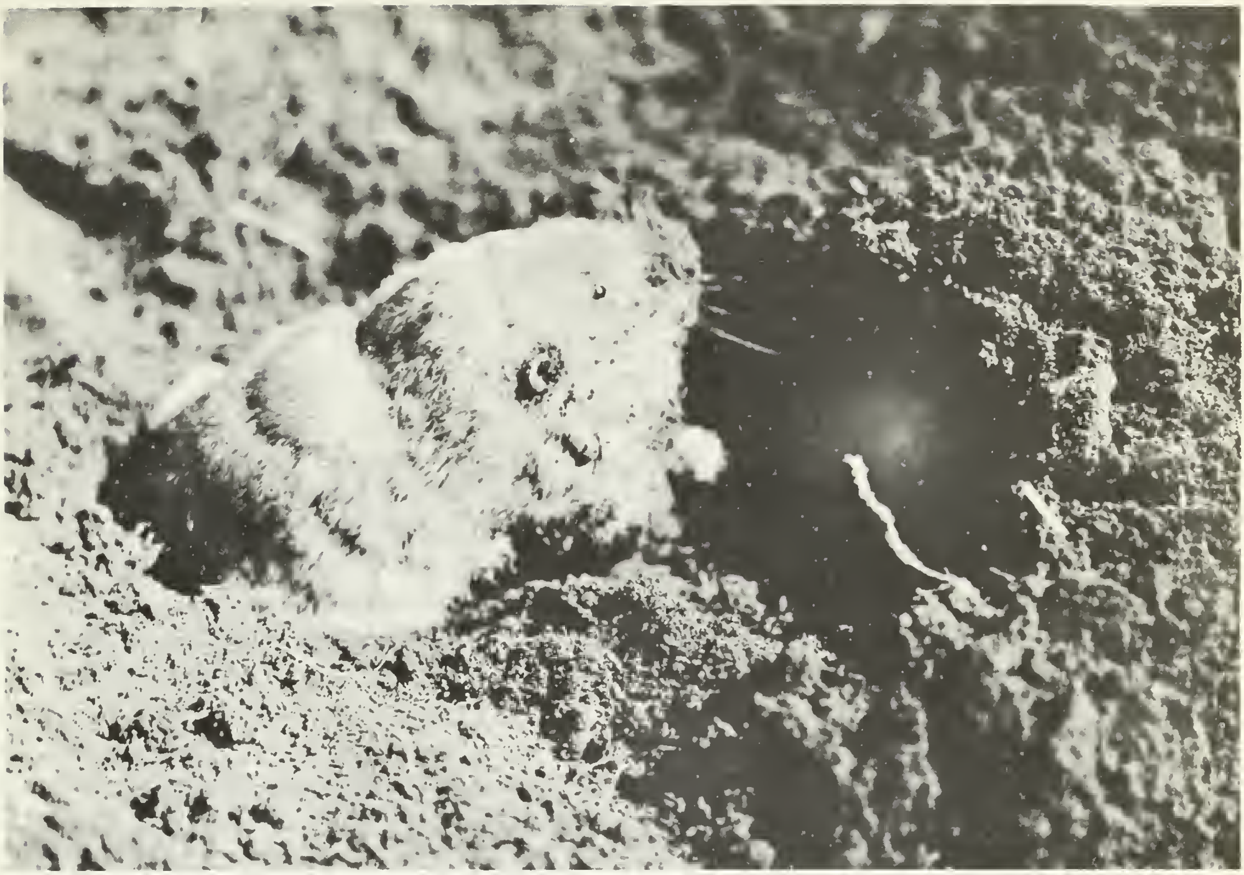

Figure 6.--The pocket gopher--a controversial figure on western rangelands.

only so many animals, but the productivity of the land varies from year to year, and so does its carrying capacity.

To learn about population dynamics of the pocket gopher, studies are being conducted on Black Mesa to determine (1) their breeding habits, (2) their longevity and movements, and (3) the carrying capacity of the range for gophers. This information will reveal problems that are likely to arise in a control program and indicate weak spots in the life cycle of the animal that may be of value in a control program.

Methods of study

On one of several study areas gophers are live-trapped and tagged. When recaptured, information is obtained on their movements, physical development, and longevity. On another area, which is surrounded by a gopher-proof fence, gophers are stocked at a much higher rate than normal to determine the gopher carrying capacity of the range at different times of the year. Gophers have been captured from numerous other areas to determine their breeding habits.

Results to date

Gophers breed from April to July and young are born from May through July. The gestation period is about 28 days.

Almost every mature female gopher produces a single litter each year. Litter size averages 4.5 on Black Mesa but may be higher or lower under different range conditions. The young may travel several hundred feet from the nest to establish their own burrow system and usually remain there the rest of their lives. They reach adult size when they are 5 to 6 months old, but do not breed until they are 1 year old.

The life expectancy of a gopher is rather short. In spring, during the breeding season, about 75 percent of the population consists of young animals born the previous year. However, some animals live at least 4 years.

During the plant growing season when vegetation is abundant and nutritious the range may support about twice as many gophers as during winter. Relatively large numbers of animals have survived during summer inside an exclosure; however, during winter, under these crowded conditions, numbers are drastically reduced.

Pocket Gopher Food Habits

Where gophers are numerous they consume large amounts of vegetation. By the determination of the kind of plants they eat and the part or parts of those plants they prefer, possible control measures may be suggested. This information is also needed to evaluate the effects of gophers on the range and in understanding why they cause certain changes in the vegetation. Studies are designed to determine (1) what gophers eat at different times of the year, (2) variation in food habits with changes in range condition, and (3) changes in gopher's diet after spraying rangeland with 2,4-D.

Methods of study

At several locations on Black Mesa where records of plant cover are available, gophers have been trapped each week during the summer. Food items in their stomachs are identified in the laboratory. As the vegetation changes with grazing treatment in the experimental pastures, it will be possible to determine whether the gopher's diet also changes. On Grand Mesa a study of the effect of spraying range plants with 2, 4-D has been completed.

Results to date

Examination was made of the contents of 213 pocket gopher stomachs collected from experimental pastures 1, 2, and 3 on Black Mesa from late June through mid-September 1957. Forbs made up 93.8 percent of the diet; grasses, 6.2 percent. Stems and leaves of forbs and grasses (aboveground vegetation) amounted to 71.2 percent of the food volume, while roots comprised only 28.8 percent.

The following seven plants made up 87.7 percent of the stomach contents: aspen fleabane (*Erigeron macranthus*), 21.8 percent; lupine (*Lupinus* spp.), 14.4 percent; slenderleaf gilia (*Collomia linearis*), 13.8 percent; common dandelion (*Taraxacum officinale*), 12.2 percent; hairy goldaster (*Chrysopsis villosa*), 11.2 percent; aspen peavine (*Lathyrus leucanthus*), 7.2 percent; and wild geranium (*Geranium fremontii*), 7.1 percent.

The Grand Mesa study revealed drastic changes in the food habits of pocket gophers following spraying the vegetation with 2, 4-D. Before spraying, 82 percent of the gopher's diet consisted of forbs but on the same area 1 year later the animals ate nearly equal amounts of grass and forbs. On untreated areas their diet remained essentially the same.

Composition of vegetation on the sprayed area changed from 75 percent forbs and 25 percent grass before treatment to 30 percent forbs and 70 percent grass after treatment.

On both treated and untreated areas in the Grand Mesa study, about two-thirds of the gopher's diet during summer months consisted of aboveground plant material. The most common food items were dandelion, western yarrow (*Achillea lanulosa*), and Rydberg penstemon (*Penstemon rydbergii*).

Pocket Gopher Effects on Range and Watershed Values

It is now known that pocket gophers eat not only roots, which may weaken or destroy range plants, but they consume forage that might otherwise be grazed by livestock. Soil from their burrows covers still other forage plants and may encourage growth of less desirable species. On the other hand, their burrowing activity may be beneficial in aerating the soil, promoting infiltration of water, and thereby increasing plant production and forage yields. The extent of these effects on range and watershed values are not known. To get at this question, studies are underway to determine how gophers affect forage production, plant composition, soil porosity, and soil moisture under different intensities of grazing by cattle.

Methods of study

In 1956 and 1957, sixteen 1-acre study areas were established within the Black Mesa experimental pastures. Eight of these are being kept free of gophers while on the others gophers are not being controlled. The study areas are distributed among pastures or cattle exclosures so two areas are being kept free of gophers and two on which gophers remain receive each of the following grazing treatments: (1) no grazing, (2) light use, (3) moderate use, and (4) heavy use.

To maintain areas free of gophers, plots were fenced with hardware cloth 2 feet below ground and 1 foot above (fig. 7). In addition, gophers are poisoned in a 200-foot belt around each of these plots to prevent invasion through the snow during the winter. Gophers were removed from the study areas in the fall of 1957. Since then these areas have been maintained relatively free of gophers.

Records of plant cover are obtained from permanent sample plots and transects in each area (fig. 8). Soil characteristics and relative abundance of other small rodents are also sampled on all areas.

Results to date

In September 1957, 171 animals or an average of 21 gophers per acre were trapped from exclosures. The fences, along with the poisoned peripheries have been quite effective in preventing gopher

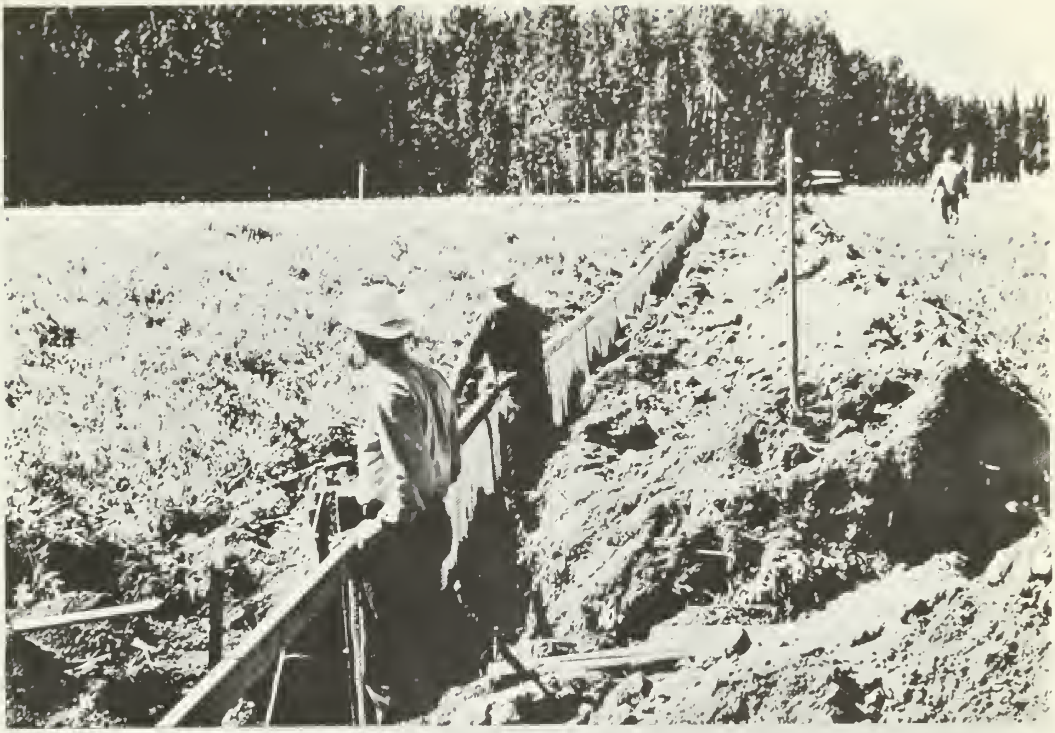

Figure 7. --Construction (upper) and finished exclosure (lower) of an area used to study pocket gophers. The low fence permits cattle grazing.

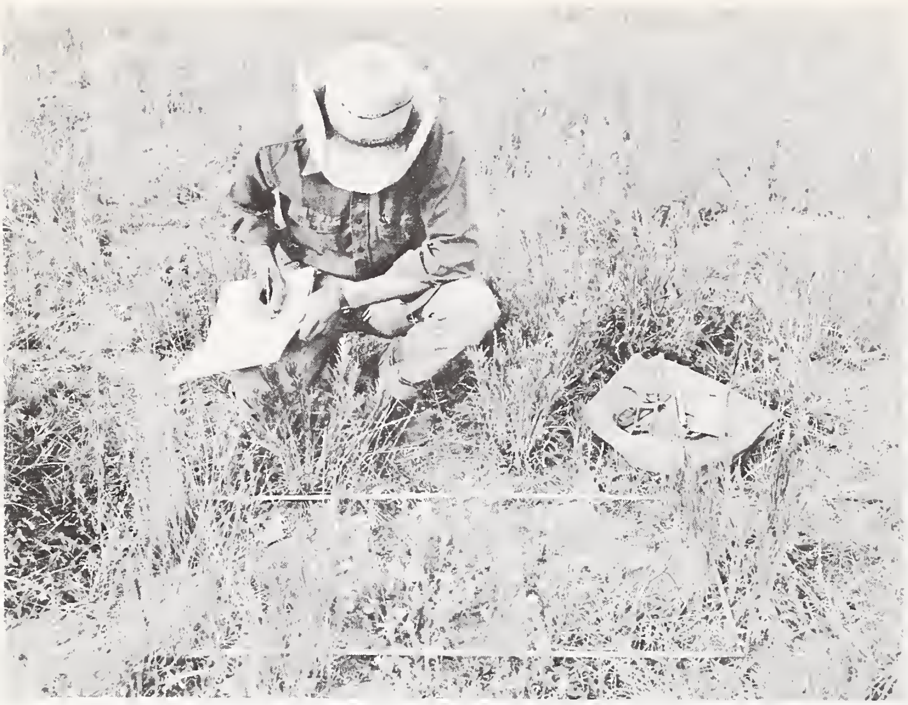

Figure 8.--Records of vegetation are obtained on permanent plots and transects in each study area. Results will show what happens to range with and without pocket gophers.

invasion. Two exclosures have been kept completely free of gophers. From 1 to 6 gophers have reinvaded five other exclosures. Peripheral poisoning is necessary. In one exclosure where the periphery the first year was not poisoned 15 animals reinvaded the exclosure.

As this work is just getting underway only conditions that existed at the beginning of the study can be reported. Herbage production was essentially the same on gopher-infested and gopher-free areas in 1957. Grasses produced an average of 455 pounds per acre on gopher-free areas and 525 pounds on gopher-infested areas. In gopher exclosures, forbs produced an average of 770 pounds compared with 796 pounds where gophers were present. On the average, herbage consisted of 35 percent grass, 55 percent forbs, and 10 percent shrubs.

The most productive species on the study plots at the present time are Idaho fescue, aspen fleabane, and Fremont geranium.

Utilization records show that cattle grazing inside gopher exclosures is not restricted by the low fences. Grazing inside the exclosures is at about the same intensity as on the gopher-present areas.

During the past 3 years gophers have covered annually, on the average, about 12 percent of the ground surface with mounds and cores. Since forage plants do not ordinarily push through or become established on this soil the first year, that part of the range remains unproductive.

Pocket Gopher Control

At present no economical method of controlling pocket gophers on rangeland is available. Cheap yet effective methods are needed if control is ever to be practical.

Methods of study

Two general methods of control are being investigated. One involves the testing of different baits and poisons and methods of application; the other is to alter the animal's habitat so that it no longer meets the requirements of the animal. Tests are being conducted both in the field and laboratory.

Results to date

A bait dispenser has been developed that greatly reduces the time required to place poison grain baits in gopher tunnels.

Food habit studies show that gophers gather much of their food aboveground. Following this lead, it was found that up to 85 percent control can be achieved by placing poison grain on fresh gopher mounds. However, results from surface-baiting tests are erratic and more information is needed to determine what conditions are necessary for best results.

The latest development in pocket gopher control is the "Burrowbuilder." This machine constructs an artificial burrow and distributes toxic baits in the burrow in one operation. It is powered by a tractor with a three-point hydraulic hitch. Tests to date show that where conditions are favorable for use of the equipment, 90 percent control of the plains pocket gopher can be obtained. Despite these promising results, additional testing will be necessary before the utility of this method in controlling mountain gophers is known. Burrows are difficult to construct in shallow or rocky soil.

Other recent developments have been the use of para-nitrophenol as a bait preservative and the use of vegetable extracts to attract gophers to poison bait. Preservatives and attractants previously tested have not been wholly satisfactory.

Spraying weedy rangelands with 2,4-D offers promise of being an effective method of reducing gopher populations. On Grand Mesa, pocket gopher numbers were reduced 87 percent 1 year after spraying. Additional studies on Black Mesa are being made to determine when a and why gopher numbers are reduced when the weeds are sprayed.

TRENDS IN RODENT NUMBERS

The degree to which utilization of the plant cover by livestock and resulting differences in range conditions affect the habitat of small rodents and thereby influence their numbers is being studied on the experimental pastures. Although rodent populations are known to fluctuate widely over a period of years or from year to year, information is needed on how they are affected by grazing management and range condition.

Methods of study

Trends in populations of meadow and deer mice are being determined by operating permanent trap lines at about the same time each year. Pocket gopher populations are being followed by counting their mounds on permanent plots.

Results to date

There has been a wide annual variation in mouse numbers, indicating the fluctuating nature of their population. During a 4-year period the mouse catch has varied from a high of about 21 animals per 100 trap nights in 1956 to a low of about 1 animal per 100 trap nights in 1957. Also, trapping records on the sixteen 1-acre study areas previously mentioned indicate that mice were about twice as numerous in 1958 as in 1957. This was true for areas where gophers were present as well as for the gopher exclosures.

More pocket gopher mounds were recorded in all pastures in 1958 than in 1957. While this presumably represents a general increase in gopher numbers, there is no indication that it was due to grazing treatment.

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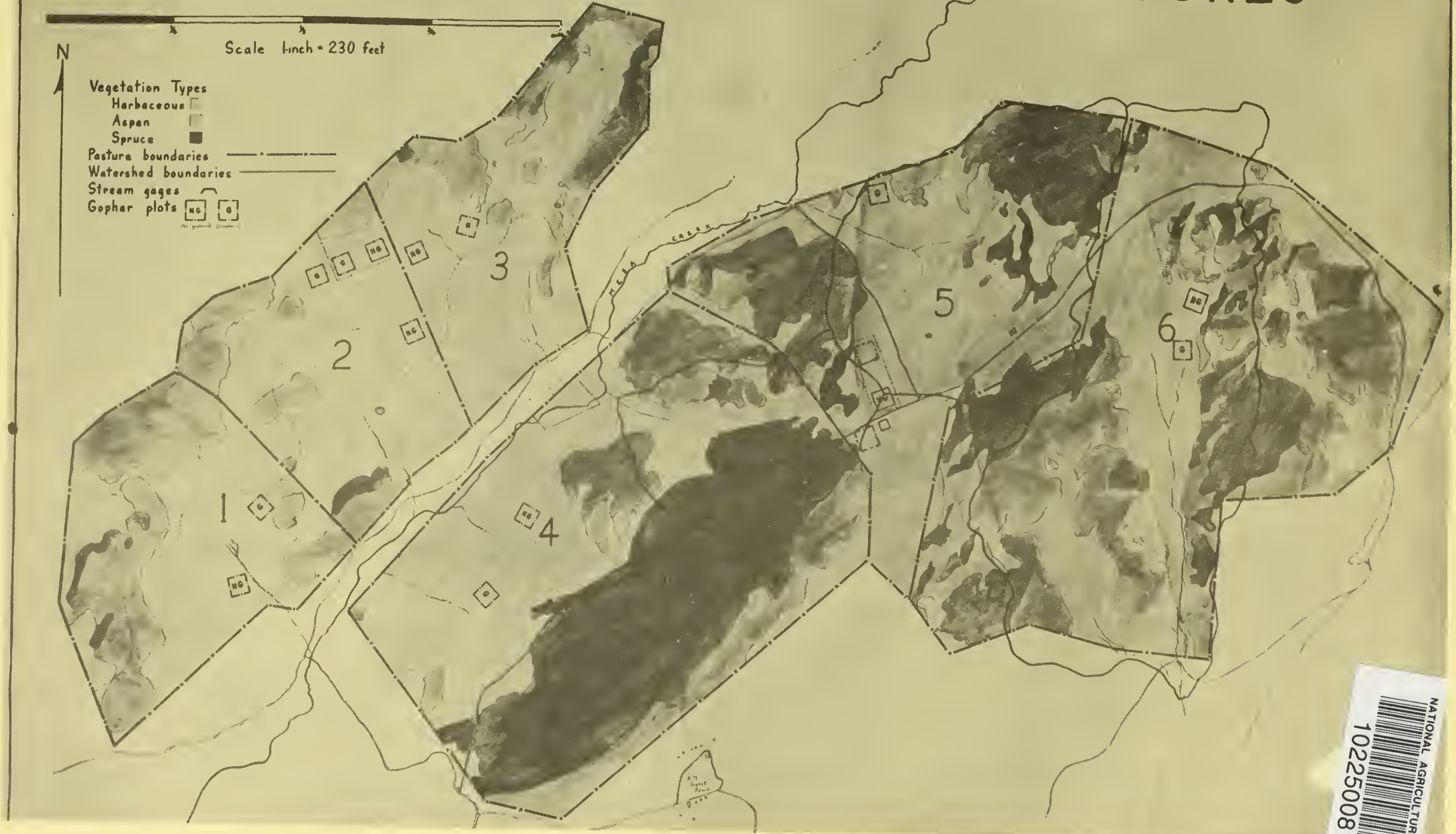
BLACK MESA EXPERIMENTAL PASTURES



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